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# Red shift by Glass prism, glass slab and other household liquidswhenlaser light is passed through them.

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**Abstract**:
First of all it all started off 7 years ago, when a blue monochromatic light from a laser pointer was passed through a prism it became green inside and emerged out blue. However when the same experiment was revisited this year the question arose that why is there a redshift taking place?Since in refraction the wavelength should be less inside as velocity of light is maximum in air or vacuum.In order to find out the answer to this question,experiments were done with laser light which was passed through the prism, glass slab and other household liquids and the details are given below.

**Introduction**:

In a triangular base prism, dispersion takes place when white light is passed through it. Since White light is composed of seven colours it is split into seven colours and different colours have different wavelengths and hence travel with different speeds. However if a monochromatic light is passed through it, dispersion may not take place as it is of single colour but refraction must surely take place.

Refraction means the change in the speed of light when it passes from one medium to another having different optical densities. Since the speed of light in air or vacuum is highest and refractive index of glass is say 1.5, Then according to the formula

$\mu = C/v$ where C is the speed of light in Vacuum and
v -the speed of light in glass.

Since v is less than C by 1.5 times, the wavelength should also reduce by 1.5 times the initial wavelength as according to the formula $v= n \lambda$ (where n = frequency and $\lambda$ is wave length).
Hence if the blue light is passed through the prism the wavelength should be less than that of blue, but the green light, which is seen inside the Prism is greater in wavelength. This is the Anomaly or rather a shift towards the red end called the redshift. This was the first observation.So, the experiments with monochromatic laser light were done, this time with green and red lights.

Firstly monochromatic green and red lights (with the help of green and red lasers) were passed through different transparent glasses and the observations are recorded.

Observations with GREEN monochromatic light Table 1

| S.No | Material through which light is passed through | ColourInside material | Emergentcolour |
|---|---|---|---|
| 1 | Glass Prism | RED | GREEN |
| 2 | Glass slab | RED | GREEN |
| 3 | Magnifying Glass | GREEN | GREEN |
| 4 | Sun Glasses | GREEN | GREEN |
| 5 | Spectacles | GREEN | GREEN |

Observations with RED monochromatic light Table2

| S.No | Material through which light is passed through | Colour Inside material | Emergent colour |
|---|---|---|---|
| 1 | Glass Prism | NO COLOUR SEEN (PROBABLY INFRARED REGION) | RED |
| 2 | Glass slab | NO COLOUR SEEN (PROBABLY INFRARED REGION) | RED |
| 3 | Magnifying Glass | RED | RED |
| 4 | Sun Glasses | RED | RED |
| 5 | Spectacles | RED | RED |

Then the same experiment is done with different liquids available at home and the observations are as follows:
Different observations with GREEN monochromatic light for different liquids Table 3

| S.No | Material through which light is passed through | Colour Inside material | Emergent colour |
|---|---|---|---|
| 1 | HONEY | YELLOW | GREEN |
| 2 | GINGELY OIL | YELLOW | GREEN |
| 3 | CASTOR OIL | YELLOW | GREEN |
| 4 | COCONUT OIL | YELLOW | GREEN |

P.T.O.

| S.No | Material through which light is passed through | Colour Inside material | Emergent colour |
|---|---|---|---|
| 5 | REFINED OIL | YELLOW | GREEN |
| 6 | NEEM OIL | FAINT YELLOW | NO COLOUR SEEN |
| 7 | APPLE CIDAR VINEGAR | YELLOW | GREEN |
| 8 | ENGINE 4T OIL | NO COLOUR SEEN | NO COLOUR SEEN |
| 9 | GHEE | GREEN | GREEN |
| 10 | MILK | NO COLOUR SEEN | NO COLOUR SEEN |
| 11 | GELUSIL | NO COLOUR SEEN | NO COLOUR SEEN |
| 12 | TAMARIND WATER | NO COLOUR SEEN | NO COLOUR SEEN |
| 13 | VASELINE | GREEN | GREEN |
| 14 | SURF EXCEL BLUE | GREEN | GREEN |

Then the same is done with red monochromatic light and the observations are as follows:
Different observations with RED monochromatic light for different liquids Table 4

| S.No. | Material through which light is passed through | Colour Inside material | Emergent colour |
|---|---|---|---|
| 1 | HONEY | FAINT RED | RED |
| 2 | GINGELY OIL | FAINT RED | RED |
| 3 | CASTOR OIL | FAINT RED | RED |
| 4 | COCONUT OIL | FAINT RED | RED |
| 5 | REFINED OIL | FAINT RED | RED |
| 6 | NEEM OIL | NO COLOUR SEEN | NO COLOUR SEEN |

| S.No. | Material through which light is passed through | Colour Inside material | Emergent colour |
|---|---|---|---|
| 7 | APPLE CIDAR VINEGAR | FAINT RED | RED |
| 8 | ENGINE 4T OIL | NO COLOUR SEEN | NO COLOUR SEEN |
| 9 | GHEE | FAINT RED | RED |
| 10 | MILK | NO COLOUR SEEN | NO COLOUR SEEN |
| 11 | GELUSIL | NO COLOUR SEEN | NO COLOUR SEEN |
| 12 | TAMARIND WATER | NO COLOUR SEEN | NO COLOUR SEEN |
| 13 | VASELINE | RED | RED |

| | | | |
|---|---|---|---|
| 14 | SURF EXCEL BLUE | RED | RED |

Thus it was found that the change in wavelength is towards the red i.e, redshift is taking place instead of blue shift (which is what expected in refraction).
So it has been concluded that a different phenomenon other than refraction is taking place here.
Literature survey shows that it has been found that a similar experiment with green laser light done with olive[1] oil and it has been found out that it is fluorescence effect[2] taking place. In thefluorescence effect,wherein the molecules in the given material absorb energy and release almost instantly a lower energy i.e. absorption of monochromatic green light of lesser wavelength and release energy in the lower frequency,[3] i.e. say yellow light in the case of liquids and red light in case of glass prism and slab.
It is also observed that the moment the incident monochromatic light is switched off, the glow or the emission of yellow or the red light is also stopped.
This fact clearly indicates fluorescence effect taking place where there is also a change in the frequency of light accompanying with change in wavelength unlike the case of refraction, where there is only change in wavelength.

**Conclusion:**
1) It is fluorescence effect that is taking place in glass prism and glass slab. A strong absorption of energy is taking place thereby the green light is becoming red and hence in the case of red monochromatic light the energy absorption is taking place and the energy emitted is in the infra-red region (refer to the photos attached here where inside prism or glass slab no color is seen).
2) All the household oils[4] like coconut oil, castor oil,gingely oil and refined oil are transparent and allow light to pass through.In fact all the liquids at S.No. 1 to 5 and 7 which show fluorescence effect are also transparent and allow light to pass through. Liquids at S.Nos. 9,13 and 14 are transparent,allow light to pass through but no fluorescence effect is taking place.
The other liquids, like milk, engine 4T oil,Gelusil and Tamarind water there is complete absorption of energy taking place. These liquids are not transparent and doesnot allow light to pass through.
In the case of Neem oil, the emergent light is not seen but faint yellow is seen within the oil. This means that there is higher absorption of energy compared to other liquids at S.No. 1 to 5 but not so high enough to be seen in the red region. Also it is not transparent like other oils. This is in line with the reasoning that the fluorescence effect is characteristic feature of the given material.
3) When red monochromatic light is passed through the same liquids shown in table no 3, there is not much change in colour inside these liquids and it remains red largely. This can be explained by the fact that in these liquids the absorption of energy is not high enough like the absorption taking place in glass prism i.e., changing from green to red. Since only about 40 to 50 nm difference is there between green to yellow (green –520nm to 560 nm and yellow 560 to 590 nm) even for small absorption the colour might change but incase of red light the range is very high (say 635 nm to 750 nm –red) and the infra red region starts from about 780 nm only.
Thus it is concluded that where there is strong absorption of energy, (glass prism and slab)then a change with red monochromatic light passing through (going in to the infra- red region) and where is low absorption (green to yellow) there is no change in the colour with red monochromatic light.

For photos of glass slab, prism and other liquids – different angles please see the link below
https://drive.google.com/drive/folders/1CCNfEraZ_URIs8KSgrdNnp1APfMXJiE4

Scope for further research: fluorescence spectra[5] for a given liquid of different brands/quality can be studied and this may be repeated for different household liquids to identify /authenticate a given brand of liquid /quality.(see ref at S.No 5).
Conflict of Interests: The authors do not have any conflict of interests in publishing this article.

**References**

**1)Fluorescence of Vegetable Oils: Olive Oils**Publication Date:January 7, 2005https://doi.org/10.1021/jf048742pMaurizioZandomeneghi, Laura Carbonaro, and Chiara Caffarata

2)Fluorescent Olive Oil | PhysicsCentralwww.physics central.com

**3)Fluorescence of solutions : A reviewR.T. Williams & J.W. Bridges, Department of Bio-Chemistry St. Mary's Hospital, Medical School, London**doi: 10.1136/jcp.17.4.371

**4) Fun with fluorescence in olive oil,** The Physics Teacher **50**, 377 (2012); https://doi.org/10.1119/1.4745700

**5) Fluorescence Spectra Measurement of Olive Oil and Other Vegetable Oils** DOI:10.1093/jaoac/83.6.1435